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**Ozawa**

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(54) **LIQUID EJECTING METHOD AND LIQUID EJECTING APPARATUS**

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**B41J 2/135** (2006.01)

(52) **U.S. Cl.**

CPC ..... **B41J 2/2114** (2013.01); **B41J 2/135** (2013.01); **B41J 2/2117** (2013.01)

(58) **Field of Classification Search**

USPC ..... 347/12, 15, 40, 43, 41  
See application file for complete search history.

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(57) **ABSTRACT**

After a gloss-based liquid is ejected from a liquid ejection head, which ejects liquid from nozzles of a nozzle row, to a predetermined position on a landing target to form a glossy layer, a white-based liquid is ejected onto the glossy layer to form a white layer, the ejection amount of the gloss-based liquid being greater than the ejection amount of the white-based liquid.

**9 Claims, 8 Drawing Sheets**

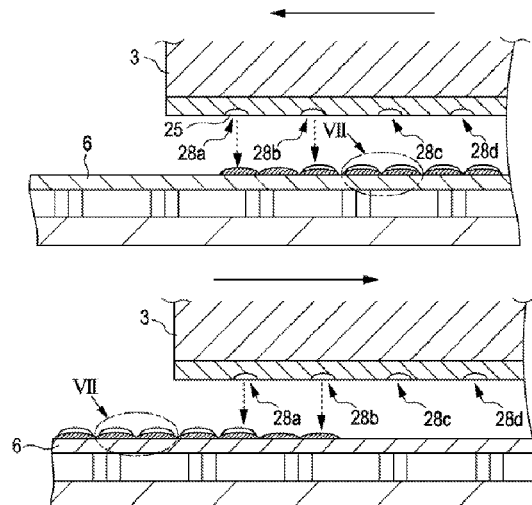




FIG. 2

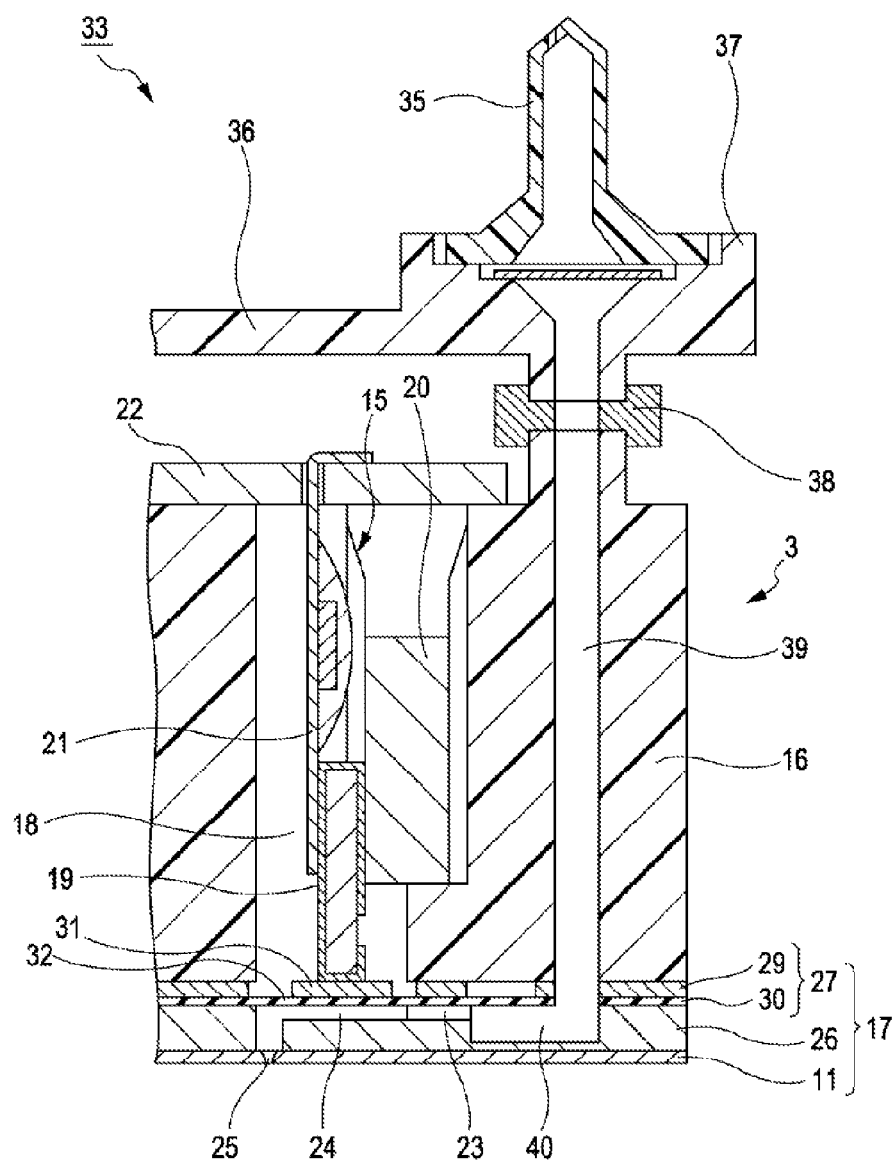


FIG. 3

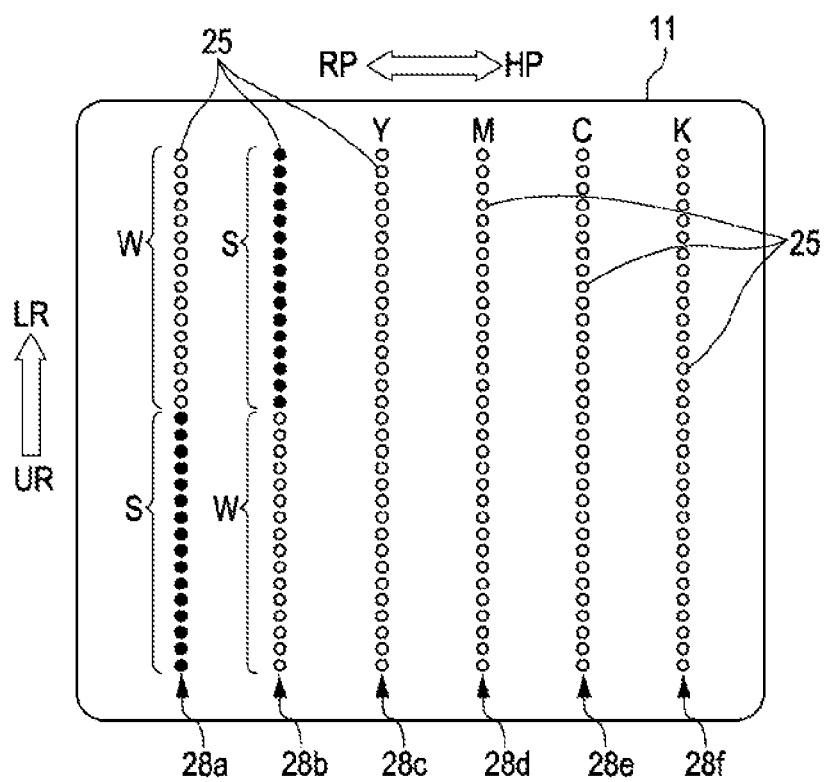


FIG. 4

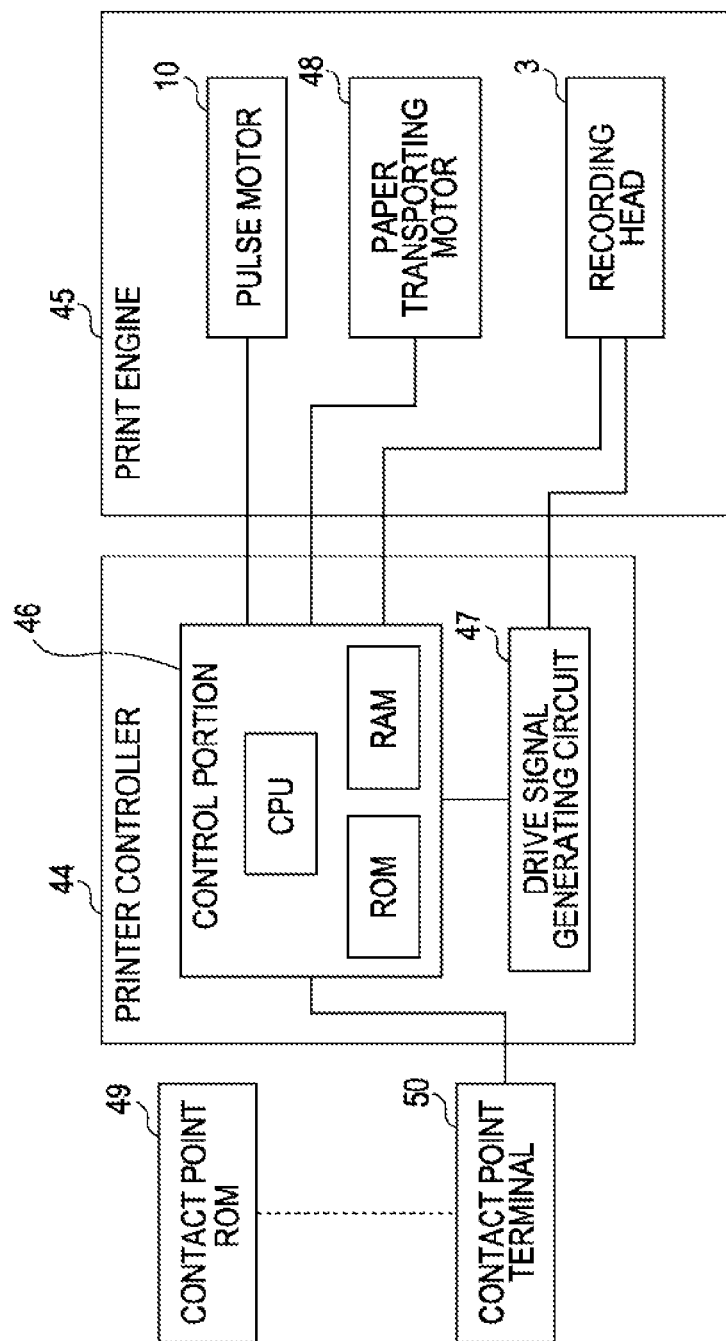


FIG. 5

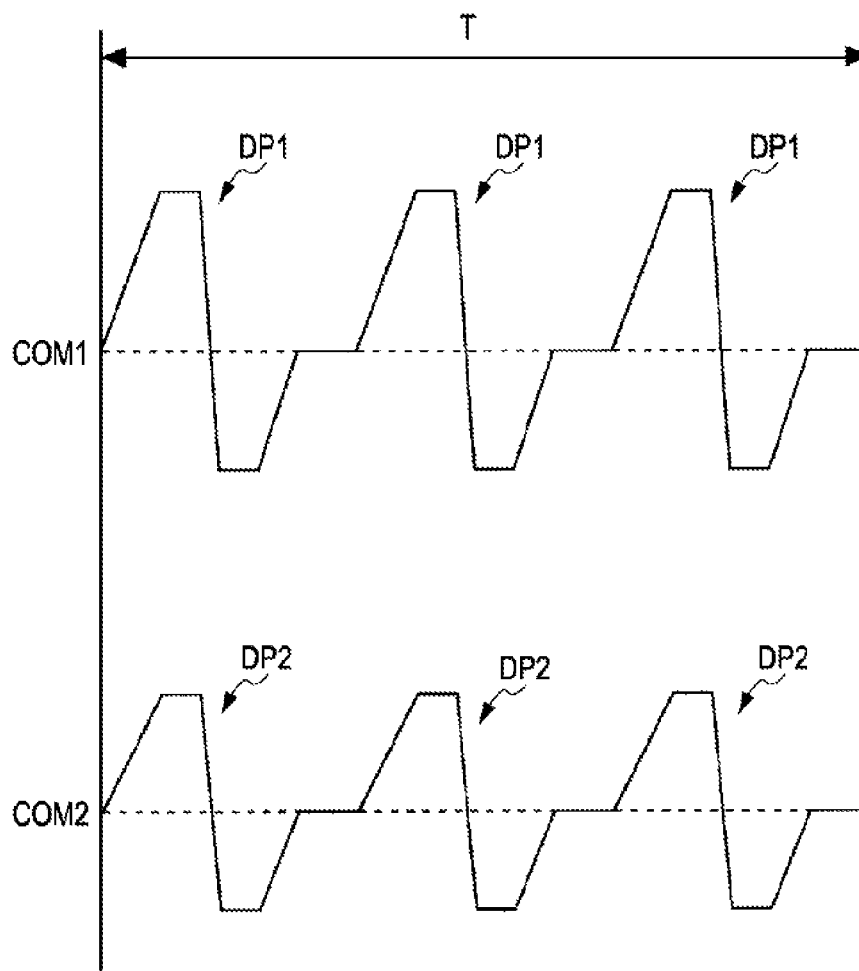


FIG. 6A

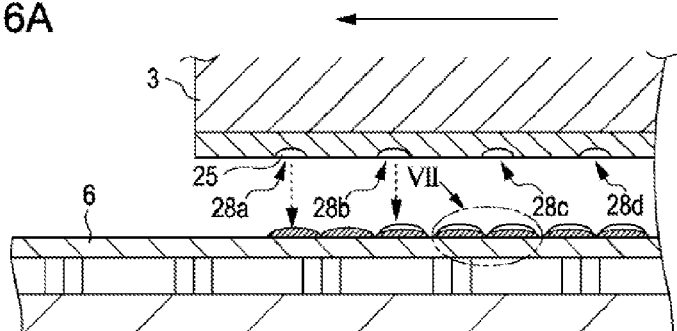


FIG. 6B

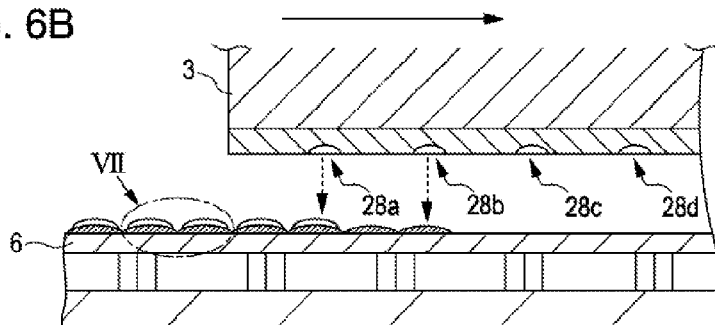


FIG. 7

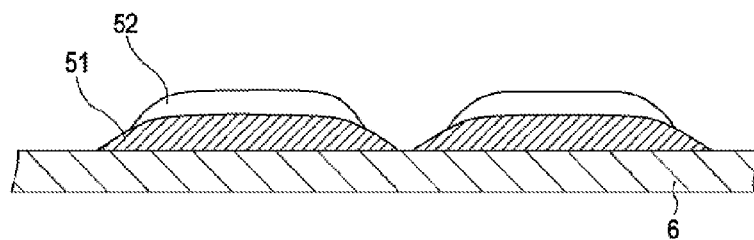


FIG. 8

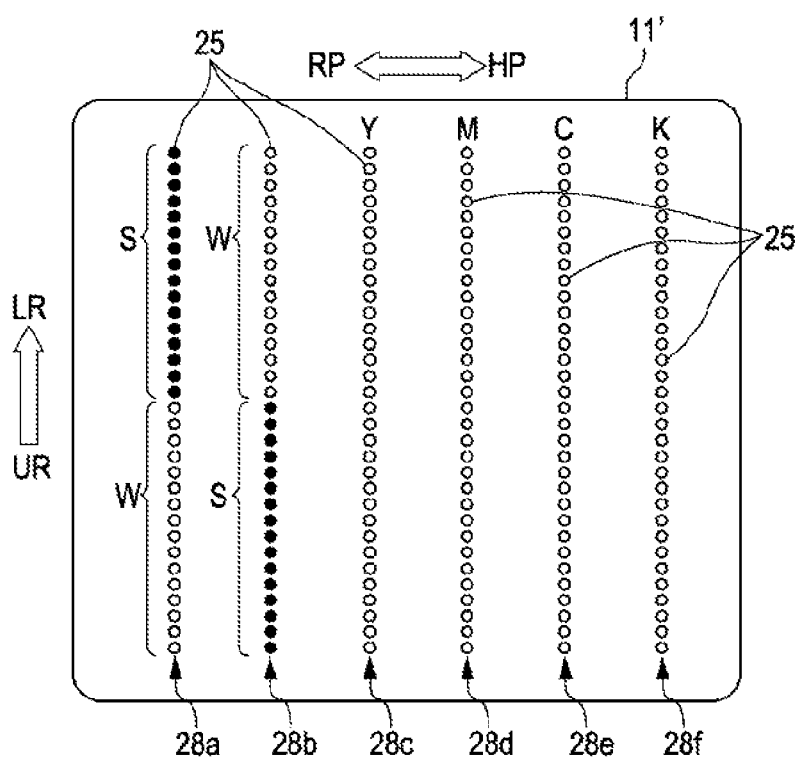




FIG. 9A

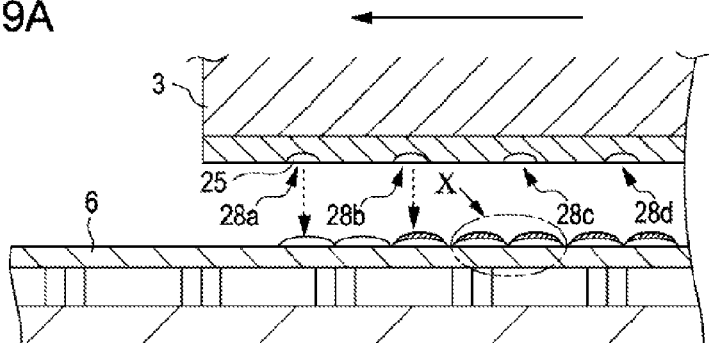


FIG. 9B

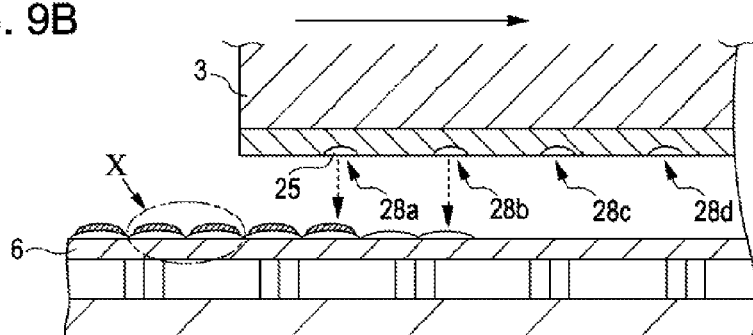
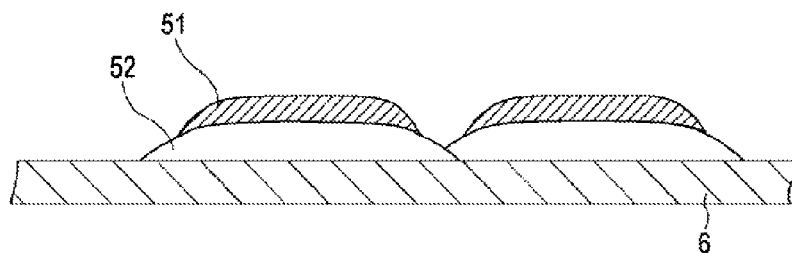


FIG. 10



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# LIQUID EJECTING METHOD AND LIQUID EJECTING APPARATUS

## CROSS REFERENCES TO RELATED APPLICATIONS

This application is a Continuation of U.S. patent application Ser. No. 13/827,406 filed Mar. 14, 2013 (which patent application is incorporated herein by reference in its entirety), which is a Divisional of application Ser. No. 13/045,888, filed Mar. 11, 2011 (which patent application is incorporated herein by reference in its entirety), which claims the benefit of Japanese Patent Application No. 2010-062165, filed Mar. 18, 2010 (which is also expressly incorporated herein by reference in its entirety).

## BACKGROUND OF THE INVENTION

### 1. Technical Field

The present invention relates to a liquid ejecting method for use in a liquid ejecting apparatus including, for example, an ink jet type recording head, and a liquid ejecting apparatus.

### 2. Related Art

In liquid ejecting apparatuses currently known in the art, printers are configured to perform various applications using a special color of ink in addition to black (K), cyan (C), magenta (M), and yellow (Y) that are colors becoming the basis of the formation of a letter or an image. For example, a printer disclosed in Japanese Patent Document JP-A-2009-126071 is configured so that the recording can be performed using a white ink including a white pigment or a silver ink including a metal pigment. By performing the recording of the image or the like using the white ink or the silver ink, a wider range of color expression is possible.

Unfortunately, however, a recording method currently used with such inks is less efficient than other printers. As such there is a need for an apparatus configuration thereof that is more effective when using the additional ink, such as white ink or silver ink.

## BRIEF SUMMARY OF THE INVENTION

A liquid ejecting method according to an embodiment of the present invention includes ejecting a gloss-based liquid from a liquid ejecting head for ejecting liquid from nozzles of a nozzle row to a predetermined position on a landing target to form a glossy layer, and ejecting a white-based liquid on the glossy layer to form a white layer, wherein, in forming the glossy layer, the liquid is discharged so that an ejection amount of the gloss-based liquid becomes greater than an ejection amount of the white-based liquid ejected when forming the white layer.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described with reference to the accompanying drawings, wherein like numbers reference like elements.

FIG. 1 is a perspective view that illustrates a configuration of a printer according to an aspect of the invention;

FIG. 2 is a partial enlarged cross-sectional view of a recording head according to an aspect of the invention;

FIG. 3 is a schematic diagram that illustrates an arrangement of a nozzle row according to an aspect of the invention;

FIG. 4 is a block diagram that illustrates an electric configuration of a printer according to an aspect of the invention;

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FIG. 5 is a diagram that illustrates a drive signal generated from a drive signal generating circuit according to an aspect of the invention;

FIG. 6A is a schematic diagram that illustrates a form of printing process at the time of a forward pass, and FIG. 6B is a schematic diagram that explains a form of printing process at the time of a returning pass;

FIG. 7 is an enlarged view of an area VII in FIGS. 6A and 6B;

FIG. 8 is a schematic diagram that illustrates an arrangement of a nozzle row in a second embodiment according to the invention;

FIG. 9A is a schematic diagram that illustrates a form of printing process of a forward pass direction in a second embodiment according to the invention, and FIG. 9B is a schematic diagram that illustrates a form of printing process of a returning pass direction in the present embodiment; and

FIG. 10 is an enlarged view of an area X in FIGS. 9A and 9B according to another aspect of the invention.

## DESCRIPTION OF EXEMPLARY EMBODIMENTS

Hereinafter, an embodiment for carrying out the invention will be described with reference to the drawings. In addition, in the embodiment described later, various limitations as desirable specific examples of the invention exist, but the scope of the invention is not limited to these aspects unless there is a description to the effect that the invention is limited in the following description. Note that, in the present embodiment, a configuration in which an image recording apparatus that is a form of a liquid ejecting apparatus, specifically, an ink jet type printer (hereinafter, referred to as a printer) with an ink jet type recording head (hereinafter, simply referred to as a recording head) as a liquid ejecting head mounted thereon will be described by way of example.

In addition, in the following description, the term “white-based” means a color that is visually recognized as white, and means that, for example, white with a slight hint of color known as off-white or ivory white is also included without being limited to white of an achromatic color.

Moreover, in the following description, the term “gloss-based liquid” means a liquid that includes a metallic powder, a pearl powder or the like as a pigment and allows visual recognition of the glossy feeling through the reflection of light by the pigment.

Firstly, the overall structure of a printer 1 will be described based on FIG. 1. The exemplified printer 1 has a carriage 4 on which a cartridge mounting portion 2 and a recording head 3 (a kind of liquid ejecting head of the invention) are provided. The carriage 4 is pivotally supported on a guide rod 5 and is mounted movably in a width direction (a main scanning direction) of a recording paper 6. A timing belt 9 spanning between a driving pulley 7 and a free rolling pulley 8 is connected to the carriage 4. In addition, the driving pulley 7 is connected to a rotational axis of a pulse motor 10. Thus, the carriage 4 moves in a width direction of the recording paper 6 (that is a kind of recording medium and a kind of landing object in the invention) by the operation of the pulse motor 10. In a given area within the movement range of the carriage 4, a home position is set, is the home position being situated at the time of standby in which the recording head 3 does not perform the recording operation relative to the recording paper 6. A wiper mechanism 12 for cleaning a surface of a nozzle plate 11 (see FIG. 2) of the recording head 3, and a capping mechanism 13 capable of sealing the nozzle forming surface are disposed in the home position.

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As the recording head, recording heads of various configurations can be used, but, in the present embodiment, the recording head 3 shown in FIG. 2 is mounted on the printer 1. The recording head 3 includes a vibrator unit 15, a case 16 capable of receiving the vibrator unit 15 therein, a flow path unit 17 that is connected to a front surface of the case 16 or the like.

The case 16 is a block-shaped member having a receiving space portion 18 for receiving the vibrator unit 15 therein and is produced, for example, by molding resin (epoxy resin or the like). The vibrator unit 15 includes a plurality of piezoelectric vibrators 19 formed in the shape, such as a comb, a fixing plate 20 to which each piezoelectric vibrator 19 is connected, and a flexible cable 21 for supplying a drive signal or the like to each piezoelectric vibrator 19.

The piezoelectric vibrator 19 is a kind of pressure generating unit. The piezoelectric vibrator 19 of the present embodiment is a laminated type piezoelectric vibrator that is produced, for example, by separating the piezoelectric plate, in which a piezoelectric layer and an electrode layer are alternately laminated over each other, in the shape such as a comb, and is a piezoelectric vibrator of a longitudinal vibration mode capable of stretching in a direction perpendicular to a stacked direction.

The fixing plate 20 is a plate material made of metal that can accept the reaction from the piezoelectric vibrator 19. The flexible cable 21 is a film-shaped wiring member having the flexibility. In addition, a terminal of one end of the flexible cable 21 is soldered to a terminal of the piezoelectric vibrator 19, and a terminal of the other side thereof is soldered to a terminal of a wiring substrate 22.

Upon applying the electric field to the piezoelectric layer constituting the piezoelectric vibrator 19, that is, upon supplying the drive signal via the flexible cable 21, the free end stretches in an element length direction (a direction perpendicular to the stacked direction). For example, when the electric potential of the vibrator is raised by the charging, the piezoelectric vibrator 19 contracts in the element length direction, and when the electric potential of the vibrator is dropped by the discharging, the piezoelectric vibrator 19 stretches in the element length direction.

The flow path unit 17 is a plate-shaped member having a series of individual liquid flow paths that lead from a liquid supply hole 23 via a pressure chamber 24 to a nozzle 25. The flow path unit 17 includes a flow path forming substrate 26 having a space portion, a groove portion or the like becoming the pressure portion 24 or the liquid supply hole 23, an elastic plate 27 that seals the opening of the space portion or the groove portion to partition a part of the pressure chamber 24 or the liquid supply hole 23, and a nozzle plate 11 in which a plurality of nozzles 25 is formed. In addition, the elastic plate 27 is connected to one surface of the flow path forming substrate 26, that is, the surface of the case side, and the nozzle plate 11 is connected to the other surface of the flow path forming substrate 26, that is, the surface of an opposite side of the elastic plate connecting surface. The configuration of the nozzle plate 11 will be described later.

The elastic plate 27 has a double structure in which an elastic body film 30 is stacked over the surface of a support plate 29. In the present embodiment, a stainless plate, which is a kind of metallic plate, is formed as the support plate 29, whereby the elastic plate 27 is produced using a complex plate material in which a resin film made of PPS (polyphenylene sulfide) or PI (polyimide) is laminated on the surface of the support plate 29 as the elastic body film 30. In the elastic plate 27, a diaphragm portion which varies the volume of the pressure chamber is provided. Furthermore, in the

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elastic plate 27, a compliance portion which seals a part of a common liquid chamber 40 is provided.

The diaphragm portion is produced by partially removing the support plate 29 through an etching machining process or the like. That is, the diaphragm portion includes an island portion 31 to which the front surface of the piezoelectric vibrator 19 is connected, and a thin elastic portion 32 surrounding the island portion 31. The compliance portion is a portion for absorbing the pressure fluctuation of the liquid stored in the common liquid chamber 40. The damper portion is also produced by removing the support plate 29 of the area facing the opening surface of the storing space portion through the etching machining or the like to leave only the elastic body film 30.

Furthermore, since the front surface of the piezoelectric vibrator 19 is connected to the island portion 31, the volume of the pressure chamber can be varied by stretching the free end. For example, when the piezoelectric vibrator 19 is charged to contract the free end in the element length direction, the island portion 31 is extended. As a result, the island portion 31 is moved, whereby the volume of the pressure chamber can be increased as compared to the discharging state of the piezoelectric vibrator 19. Moreover, when the piezoelectric vibrator 19 of the charged state is discharged to stretch the free end in the element length direction, the island portion 31 is pushed to the pressure chamber 24 side. As a result, the volume of the pressure chamber can be reduced as compared to the charged state of the piezoelectric vibrator 19.

A supply needle unit 33 is provided in the cartridge mounting portion 2. The supply needle unit 33 is a portion connected to a liquid cartridge 34 (a kind of liquid supply source) in which liquid is stored, and the liquid stored in the liquid cartridge 34 is supplied into the recording head 3 via the supply needle unit 33. In addition, as the liquid supply source, a liquid storage pack (a storage body in which liquid is stored) may be used without being limited to the liquid cartridge 34. Furthermore, it is also possible to adopt a configuration in which a liquid supply source such as the liquid cartridge 34 is disposed at the main body side of the printer 1 and ink is supplied from the liquid supply source through the ink supply tube to the recording head 3. Moreover, a configuration, in which the liquid storage tank is disposed outside the printer and the tank is directly or indirectly connected to the flow path of the inner portion of the printer, may be adopted.

The supply needle unit 33 in the present embodiment is roughly constituted by a liquid supply needle 35 and a needle holder 36. The liquid supply needle 35 is a member that is inserted into the inner portion of the liquid cartridge 34, and introduces the liquid, which was stored in the liquid cartridge 34, into the needle. The top of the liquid supply needle 35 is sharpened in a conical shape, and a plurality of liquid introduction holes extending between the inside and outside the needle are formed. The needle holder 36 is a member for attaching the liquid supply needle 35, and the surface thereof is formed with a pedestal 37 for fixedly attaching a root portion of the liquid supply needle 35.

The supply needle unit 33 is disposed on the attachment surface of the case 16. In the disposition state, a liquid outlet and the connection protrusion of the case 16 communicate with each other via a packing 38 in a liquid-tight state. In addition, at the inside of the connection protrusion, a liquid supply path 39 passing through the case 16 is formed. The liquid supply path 39 communicates with the common liquid chamber 40 of the flow path unit 17. Thus, the liquid stored in the liquid cartridge 34 flows in the common liquid chamber 40 through the liquid supply path 39.

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In the recording head **3** and the supply needle unit **33**, there is formed a series of liquid flow paths that lead from the liquid supply needle **35** through the common liquid chamber **40** and the pressure chamber **24** to the nozzle **25**. In addition, upon operating the piezoelectric vibrator **19**, the volume of the pressure chamber can be changed as described above. By the fluctuation in the volume of the pressure chamber, the pressure fluctuation occurs in the liquid within the pressure chamber **24**, and thus, the liquid pressure in the pressure chamber **24** can be changed, whereby the liquid droplets can be ejected from the nozzle **25**. For example, when the piezoelectric vibrator **19** is charged to expand the pressure chamber **24** and then the piezoelectric vibrator **19** is rapidly discharged to contract the pressure chamber **24**, the liquid flowed in the pressure chamber **24** is rapidly pressurized by the expansion of the pressure chamber **24** and the liquid droplets are ejected from the nozzle **25**.

As the ink ejected from the printer **1**, for example, a pigment ink is used. The ink is regulated so that a pigment concentration, a moisturizer concentration or the like is suitable for the application of the image printing or the like. In addition, in the present embodiment, total 6 colors of inks of black ink (K), cyan ink (C), magenta ink (M), yellow ink (Y), white ink (W), and silver ink (S) are used. As these inks, it is desirable to use an ultraviolet curable ink (a UV ink: a kind of photo curable liquid). The ultraviolet curable ink is different from a normal water-based ink in that, after landing the ink on the recording medium (an object to be landed), by irradiating the ultraviolet from an ultraviolet irradiation unit (not shown) with respect to the landing position to cure the ink, a stable printing quality can be secured without being influenced by the physical property of the recording medium such as the ink permeability.

Herein, the white ink is an ink that contains a white-based pigment, and is a kind of the white-based liquid in the invention. As the white-based pigment, for example, titanium dioxide can be suitably used. Furthermore, the silver ink is an ink including the gloss-based pigment and a kind of the gloss-based liquid in the invention. As the gloss-based pigment, for example, it is possible to use a powder-type or paste-type metal pigment formed of a metal such as aluminum, and a pearl pigment formed of mica titanium or the like in which the surface of mica is coated with the metal oxide. The printer **1** is configured so that a special visual effect can be obtained in the recording image using the white ink or the silver ink. This point will be described later.

Next, an allocation of each color of ink to the nozzle row will be described.

FIG. 3 is a top plan view that explains the configuration of the nozzle plate **11**. In FIG. 3, a left and right direction is a main scanning direction, a right side thereof is a home position side (HP), and a left side thereof is a recording area side (RP). Furthermore, an up and down direction in FIG. 3 is a sub-scanning direction (a transportation direction of the recording paper **6**), a lower side thereof is an upstream side (UR), and an upper side is a downstream side (LR). The nozzle plate **11** is a thin plate formed of the metal or the like in which a plurality of nozzles **25** is formed in a pitch corresponding to the dot formation density. In the nozzle plate **11** in the present embodiment, a plurality of nozzles **25** is provided in rows in a direction equivalent to the sub-scanning direction to constitute each nozzle row **28a-28f**, whereby a plurality of nozzle rows **28a-28f** is formed in a direction equivalent to the main scanning direction. In the present embodiment, six rows of nozzle rows **28a-28f** are formed. Each nozzle row **28a-28f** is formed of 360 nozzles **25** that are opened, for example, by the pitch corresponding to 360 dpi.

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In the present embodiment, a first nozzle row **28a** corresponding to the white ink (W) and the silver ink (S), a second nozzle row **28b** corresponding to the white ink (W) and the silver ink (S), a third nozzle row **28c** corresponding to the yellow ink (Y), a fourth nozzle row **28d** corresponding to the magenta ink (M), a fifth nozzle row **28e** corresponding to the cyan ink (C), and a sixth nozzle row **28f** corresponding to the black ink (K) are formed in rows in the direction corresponding to the main scanning direction.

Herein, there is a relative positional relationship in which, at the time of being on the forward pass of the recording head **3** in the main scanning direction, the first nozzle row **28a** becomes the front side (from which ink is first ejected), and the second nozzle row **28b** becomes the rear side. On the other hand, at the time of being on the returning pass thereof, the second nozzle row **28b** becomes the front side and the first nozzle row **28a** becomes the rear side. The first nozzle row **28a** is divided into two nozzle groups including the nozzle group (shown by black circles in the drawing) of an upstream side half (**180**) in the sub-scanning direction and the nozzle group of a downstream side half (**180**) in the same direction, and the liquid flow paths of both nozzle groups are also separated from each other. In addition, it is configured so that the nozzle group disposed at the upstream side ejects the silver ink (S), and the nozzle group disposed at the downstream side ejects the white ink (W). Thus, the nozzle group of the upstream side of the first nozzle row **28a** is equivalent to the gloss-based correspondence nozzle group and the downstream nozzle group thereof is equivalent to the white-based correspondence nozzle group. Similarly, the second nozzle row **28b** is configured so that the nozzle group disposed at the upstream side thereof ejects the white ink (W) and the nozzle group (shown by black circles in the drawing) disposed at the downstream side thereof ejects the silver ink (S). The nozzle group of the upstream side of the second nozzle row **28b** is equivalent to the white-based correspondence nozzle group, and the downstream side nozzle group thereof is equivalent to the gloss-based correspondence nozzle group. In addition, the first nozzle row **28a** and the second nozzle row **28b** are disposed in the state of being adjacent to each other without other nozzle row being disposed therebetween. Moreover, the first nozzle row **28a** and the second nozzle row **28b** are disposed relatively in the same position in the main scanning direction. For example, it is not preferable to adopt an arrangement in which the second nozzle row **28b** deviates with respect to the nozzle pitch of the first nozzle row **28a** by the half pitch. This arrangement is caused by the fact that after ejecting the silver ink, the white ink is ejected to and landed on the landing position of the silver ink in the present embodiment. The details thereof will be described later.

Next, the electric configuration of the printer **1** will be described. As shown in FIG. 4, the printer **1** is roughly constituted by a print controller **44** and a print engine **45**.

The print controller **44** includes a control portion (a kind of control unit) including a CPU, a ROM and a RAM, a drive signal generating circuit **47** (a kind of drive signal generating unit) that generates the drive signal for supplying to the recording head **3** or the like. On the other hand, the print engine **45** includes a pulse motor **10** (a kind of relative movement unit), a paper transporting motor **48** (a kind of landing object transporting unit), and the recording head **3** or the like. In addition, the operations of the respective portions can be controlled by the control portion **46**.

The control portion **46** is a portion that performs the control in the printer **1**. The control portion **46** is electrically connected to a contact point terminal **50**, and thus it is possible to

read various pieces of information stored in a contact point ROM 49 of the mounted liquid cartridge 34. For this reason, the control portion 46 can recognize the type or the like of ink stored in the liquid cartridge 34 based on the read information. Furthermore, the control portion 46 can redraft various pieces of information stored in the contact point ROM 49.

The control portion 46 creates the dot pattern data for controlling the recording head 3 based on the print data that is transmitted from an external apparatus such as a host computer. In addition, the control portion 46 transmits the created dot pattern data to the recording head 3. Furthermore, the control portion 46 also serves as a drive signal setting unit, sets the drive signal of the waveform suitable for the printing the image or the like, and generates the drive signal from the drive signal generating circuit 47. In addition, the control portion 46 operates the pulse motor 10 to move the carriage 4 (the recording head 3) to a desired position or operates the paper transporting motor 48 to deliver the recording paper 6.

The drive signal generating circuit 47 is a portion that serves as the drive signal generating unit, and generates the drive signal for supplying to the recording head 3 under the control by the control portion 46. As shown in FIG. 5, the drive signal generating circuit 47 of the present embodiment can concurrently generate two types of drive signals COM1 and COM2.

Hereinafter, each drive signal will be described. The first drive signal COM1 is a series of signals that include three first drive pulses DP1, which are set so as to enlarge the ejection amount of the liquid droplet as much as possible, within a unit period that is a repeating period of the drive signal and is divided into a timing signal such as a latch pulse at equal distances. The first drive pulse DP1 is a drive pulse which sets the drive voltage, that is, the electric potential difference between a maximum electric potential and a minimum electric potential as high as possible up to an extent that is allowable by the piezoelectric vibrator 19. In addition, whenever the first drive pulse DP1 is supplied to one piezoelectric vibrator 19, the maximum amount of ink droplets is ejected from the nozzle 25. In the present embodiment, when the silver ink is mainly ejected, the first drive pulse DP1 is used.

As shown in FIG. 5, the second drive signal COM2 is a series of signals that includes three second drive pulses DP2 within the unit period at equal distances. The second drive pulse DP2 is a drive pulse which is set so that the amount of the ejected ink droplet becomes smaller than the case of the first drive pulse DP1, while the basic waveform shape thereof is the same as that of the first drive pulse DP1. More particularly, the second drive pulse DP2 is different from the first drive pulse DP1 in that the drive voltage is set to be lower than that of the first drive pulse DP1. In the present embodiment, in a case where ejecting the ink other than the silver ink, the second drive pulse DP2 is used. In addition, the first drive pulse DP1 and the second drive pulse DP2 are configured so that the drive voltages thereof are different from each other, but the present invention is not limited thereto. For example, by making the drive voltages of both equal to each other and making the slope of the electric potential change of the second drive pulse DP2 gentler than that of the first drive pulse DP1, the amount of the ink droplets ejected by the second drive pulse DP2 may be smaller than the case of the first drive pulse DP1.

Next, in the printer 1 having the configuration as mentioned above, the printing process using the silver ink and the white ink will be described. In this printing process, the silver ink is ejected onto the recording medium such as the recording paper 6 in advance to print the recording medium using the silver ink layer (forming the glossy layer of the invention)

as a base, and then, the white ink is ejected onto the silver ink layer to form the white ink layer in an overlapping manner (forming the white layer of the invention).

When the power supply is turned on, the control portion 46 carries out a predetermined initializing operation. In the initializing operation, the carriage 4 is operated in the main scanning direction, thereby performing the position recognition of the carriage 4 (the recording head 3) or the like, or clearing unnecessary information within the work area. If the initializing operation has been performed, the control portion 46 controls the pulse motor 10 or the paper transporting motor 48, thereby moving the carriage 4 in the main scanning direction (equivalent to the relative movement direction in the invention) and delivering the recording paper 6 in the sub-scanning direction (equivalent to the transportation direction in the invention). In addition, the control portion 46 controls the supply of the first drive pulse DP1 and the second drive pulse DP2 to the piezoelectric vibrator 19 in synchronization with the movement of the carriage 4 or the recording paper 6.

FIG. 6A is a schematic diagram that explains the aspect of the printing process (the recording process) in the forward pass direction (equivalent to a first relative movement direction) in which the recording head 3 performs the ejection of ink from the nozzle 25 while moving from one home position side in the main scanning direction to the other side thereof. Furthermore, FIG. 7 is an enlarged view of an area VII in FIGS. 6A and 6B. As shown in FIG. 6A, in the forward pass, the silver ink is ejected from the gloss-based correspondence nozzle group (S) disposed at the upstream side of the first nozzle row 28a in the sub-scanning direction by the first ejection pulse DP1 and is landed in a predetermined position of the recording paper 6. As a result, the silver ink layer 51 is formed on the recording paper 6. Then, at the timing when the recording head 3 is moved by the gap of the adjacent nozzle rows, the white ink is ejected from the white-based correspondence nozzle group disposed at the upstream side of the second nozzle row 28b in the sub-scanning direction by the second drive pulse DP2 and is landed on the silver ink layer 51 that was formed in advance. As a result, as shown in FIG. 7, the white ink layer 52 is formed on the silver ink layer 51 in an overlapped manner. In this manner, the printing process of the forward pass is performed while alternately ejecting the silver ink and the white ink from the recording head 3 in an overlapped manner.

FIG. 6B is a schematic diagram that explains the aspect of the printing process in the returning pass direction (equivalent to a second relative movement direction) in which the recording head 3 performs the ejection of ink from the nozzle 25 while moving from the other side in the main scanning direction to one home position side thereof. When the printing process of the forward pass is finished, the recording paper 6 is transported to the downstream side of the sub-scanning direction by the half of the nozzle row, that is, the distance corresponding to the length of one nozzle group through the operation of the paper transporting motor 48, and then the printing process of the returning pass is performed. As shown in FIG. 6B, in the returning pass, the silver ink is ejected from the gloss-based correspondence nozzle group (S) disposed at the downstream side of the second nozzle row 28b in the sub-scanning direction by the first drive pulse DP1, and is landed in a predetermined position of the recording paper 6, whereby the silver ink layer 51 is formed. Then, at the timing when the recording head 3 is moved by the gap of the adjacent nozzle rows, the white ink is ejected from the white-based correspondence nozzle group disposed at the downstream side of the first nozzle row 28a in the sub-scanning direction by the second drive pulse DP2 and is landed on the silver ink

layer **51** that was formed in advance. As a result, in the same manner as the case of the forward pass, the white ink layer **52** is formed on the silver ink layer **51** in an overlapped manner. In this manner, the printing process of the returning pass is performed while alternately ejecting the silver ink and the white ink in an overlapped manner.

In this manner, by performing the printing process while alternately ejecting the silver ink and the white ink in the forward pass and the returning pass, the ground color of the recording medium such as the recording paper **6** is covered over the silver ink layer **51** and is concealed and the white ink layer **52** is formed thereon using the silver ink layer **51** as a base, and thus, the glossy feeling of the silver ink layer **51** can be obtained. As a result, as compared to a case of directly forming the white ink layer **52** on the recording medium, the brightness of the white ink layer **52** can be heightened, with the result that the white coloring can be further accentuated.

In addition, in the present embodiment, the amount of the ink droplets when the silver ink is ejected is set to become larger than that when the white ink is ejected, and thus, the area covered by the silver ink layer **51** becomes greater than that of the white ink layer **52**. As a result, the ground color of the recording medium of the silver ink layer **51** is more reliably concealed and the glossy feeling is further emphasized, and thus, the coloring of the white ink layer **52** can be further accentuated. In addition, even if, particularly, the recording medium is a resin film or the like through which light is transmitted, by the concealment action of the silver ink layer **51** being the base, the coloring property of ink to be formed thereon can be secured. In addition, in the printer **1**, it is possible to effectively perform the recording both in the forward pass and the returning pass.

Herein, in the above-mentioned embodiment (the first embodiment), the configuration, in which white is accentuated by forming the white ink layer **52** thereon using the silver ink layer **51** as the base, has been described, but the invention is not limited thereto, on the contrary, the metallic texture can be accentuated by forming the silver ink layer thereon using the white ink layer as the base.

FIG. **8** is a top plan view that explains a configuration of a nozzle plate **11'** in a second embodiment. The difference from the first embodiment is the allocation of the silver ink and the white ink in the first nozzle row **28a** and the second nozzle row **28b**, and other configurations are the same as those of the first embodiment, and thus the description thereof will be omitted. The first nozzle row **28a** in the present embodiment is configured so that the nozzle group of the upstream side half of the sub-scanning direction ejects the white ink (W) and the nozzle group disposed at the downstream side ejects the silver ink (S). Thus, the nozzle group of the upstream side of the first nozzle row **28a** is equivalent to the white-based correspondence nozzle group, and the nozzle group of the downstream side thereof is equivalent to the gloss-based correspondence nozzle group. Similarly, the second nozzle row **28b** is configured so that the nozzle group disposed at the upstream side thereof ejects the silver ink (S) and the nozzle group disposed at the downstream side thereof ejects the white ink (W). Thus, the nozzle group of the upstream side of the second nozzle row **28b** is equivalent to the gloss-based correspondence nozzle group, and the nozzle group of the downstream side is equivalent to the white-based correspondence nozzle group. In addition, the first nozzle row **28a** and the second nozzle row **28b** are in the adjacent state without other nozzle rows disposed therebetween.

Next, the printing process using the silver ink and the white ink in the present embodiment will be described. In the printing process, after the white ink is ejected onto the recording

medium such as the recording paper **6** in advance to perform the printing using the white ink layer as the base, the silver ink is ejected onto the white ink layer to form the silver ink layer in an overlapping manner.

FIG. **9A** is a schematic diagram explaining the aspect of the printing process in the forward pass direction in the present embodiment. Furthermore, FIG. **10** is an enlarged view of an area X in FIGS. **9A** and **9B**. As shown in FIG. **9A**, in the forward pass, the white ink is ejected from the white-based correspondence nozzle group (W) disposed at the upstream side of the first nozzle row **28a** in the sub-scanning direction by the first ejection pulse DP1 and is landed in a predetermined position of the recording paper **6**. As a result, the white ink layer **52** is first formed on the recording paper **6**. Then, at the timing when the recording head **3** is moved by the gap of the adjacent nozzle rows, the silver ink is ejected from the gloss-based correspondence nozzle group disposed at the upstream side of the second nozzle row **28b** in the sub-scanning direction by the second drive pulse DP2 and lands on the white ink layer **52** that was formed in advance. As a result, as shown in FIG. **10**, the silver ink layer **51** is formed on the white ink layer **52** in an overlapping manner. In this manner, the printing process of the forward pass is performed while alternately ejecting the white ink and the silver ink from the recording head **3** in an overlapping manner.

FIG. **9B** is a schematic diagram that explains the aspect of the printing process of the returning pass direction in the present embodiment. When the printing process of the forward pass is finished, the recording paper **6** is transported to the downstream side of the sub-scanning direction by half of the nozzle row, that is, the distance corresponding to the length of one nozzle group through the operation of the paper transporting motor **48**, and then the printing process of the returning pass is performed. As shown in FIG. **9B**, in the returning pass, the white ink is ejected from the white-based correspondence nozzle group (W) disposed at the downstream side of the second nozzle row **28b** in the sub-scanning direction by the first drive pulse DP1, and is landed in a predetermined position of the recording paper **6**, whereby the white ink layer **52** is formed. Then, at the timing when the recording head **3** is moved by the gap of the adjacent nozzle rows, the silver ink is ejected from the gloss-based correspondence nozzle group disposed at the downstream side of the first nozzle row **28a** in the sub-scanning direction by the second drive pulse DP2 and is landed on the white ink layer **52** that was formed in advance.

As a result, in the same manner as the case of the forward pass, the silver ink layer **51** is formed on the white ink layer **52** in an overlapping manner. In this manner, the printing process of the returning pass is performed while alternately ejecting the white ink and the silver ink in an overlapping manner.

In this manner, by performing the printing process while alternately ejecting the white ink and the silver ink in both directions of the forward pass and the returning pass, the ground color of the recording medium such as the recording paper **6** is covered by the white ink layer **52** and is concealed and the silver ink layer **51** is formed thereon using the white ink layer **52** as the base. Thus, as compared to a case of directly forming the silver ink layer **51** on the landing object, the brightness of the silver ink layer **51** can be heightened, with the result that the metallic glossy feeling of silver ink layer **51** can be further accentuated.

In addition, in the present embodiment, the first drive pulse DP1 and the second drive pulse DP2 can be used separately so that the amount of the ink droplets when the white ink is ejected is set to become larger than that when the silver ink is ejected. Thus, the covering area of the white ink layer **52**

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becomes greater than that of the silver ink layer **51**. As a result, the ground color of the recording medium can be more reliably concealed by the white ink layer **52** and the glossy feeling is further emphasized, and thus, the glossy feeling of the silver ink layer **51** can be further accentuated. In addition, particularly, even if the recording medium is a resin film or the like through which light is transmitted, by the concealment action of the white ink layer **52** which is the base, the coloring property of ink to be formed thereon can be secured.

The present invention is not limited to the above-mentioned embodiment but can be variously modified based on the description of the claims.

In each embodiment, the description has been given of the configuration in which the recording head **3** (the carriage **4** with the same mounted thereon) is relatively moved with respect to the recording medium of the stationary state in the reciprocating printing process in the main scanning direction, but the invention is not limited thereto. For example, it is also possible to adopt a configuration in which the recording medium is relatively moved with respect to the recording head **3** in the state in which the position of the recording head **3** is fixed.

Moreover, in the above-mentioned embodiment, the invention was described using one recording head **3**, which includes for example, the first nozzle row **28a** corresponding to the white ink (W) and the silver ink (S), the second nozzle row **28b** corresponding to the white ink (W) and the silver ink (S), the third nozzle row **28c** corresponding to the yellow ink (Y), the fourth nozzle row **28d** corresponding to the magenta ink (M), the fifth nozzle row **28e** corresponding to the cyan ink (C), and the sixth nozzle row **28f** corresponding to the black ink (K) are formed so as to be arranged in the direction corresponding to the main scanning direction.

However variations may be made wherein, for example, the recording head in which the first nozzle row **28a** corresponding to the white ink (W) and the silver ink (S), and the second nozzle row **28b** corresponding to the white ink (W) and the silver ink (S) are provided and the recording head with the nozzle rows of other colors provided therein may be individually provided without being limited to this form. In addition, the recording head with the first nozzle row **28a** corresponding to the white ink (W) and the silver ink (S) provided therein and the recording head with the second nozzle row **28b** corresponding to the white ink (W) and the silver ink (S) provided therein may be separated from each other, and the "recording head" and the "liquid ejection head" of the invention are interpreted as collectively expressing that a plurality of recording heads (the liquid ejection heads) is provided.

Furthermore, the drive signal for driving the piezoelectric vibrator **19** and the drive pulse included therein are not limited to those indicated in the above-mentioned embodiment, but can adopt an arbitrary configuration. In short, a configuration, in which the amount of ink forming the base becomes larger than the amount of the ink to be landed on the base, may be adopted.

Moreover, in the above-mentioned embodiment, the first nozzle row **28a** and the second nozzle row **28b** were provided by dividing the white ink nozzles and the silver ink nozzles equally respectively. However, for example, depending on the printing data, the white ink nozzles of the first nozzle row **28a** may be provided in a greater number than the silver ink nozzles, and the white ink nozzles of the second nozzle row **28b** may be provided so as to relatively reduce the silver ink nozzles of the second nozzle row **28b** in view of the number

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of the silver ink nozzles of the first nozzle row **28a**, without being limited to that indicated in the above-mentioned embodiment.

In addition, the example described above is an ink jet type recording printer. However, the invention is not limited thereto. The invention can be applied to other liquid ejection apparatuses, for example, a color material ejection apparatus used in manufacturing a color filter of a liquid crystal display or the like, an electrode material ejection apparatus used in forming the electrode of an organic EL display, a FED or the like, and a vital organic matter ejection apparatus or the like used in manufacturing a bio chip, if they have a configuration which lands two kinds of liquids on the landing object in an overlapping manner.

What is claimed is:

1. A liquid ejecting apparatus comprising:

a white-based nozzle group that ejects a white-based liquid;

a gloss-based nozzle group that ejects a gloss-based liquid; and

a control portion that forms a white layer by using the white-based nozzle group and a glossy layer by using the gloss-based nozzle group;

wherein, the control portion forms another layer onto one layer of the white layer and the glossy layer.

2. The liquid ejecting apparatus according to claim 1, wherein the control portion makes an amount of a liquid using the one layer greater than an amount of a liquid using the another layer.

3. The liquid ejecting apparatus according to claim 1, wherein the control portion forms the white layer onto the glossy layer.

4. The liquid ejecting apparatus according to claim 1, wherein the control portion makes an amount of the gloss-based liquid using the glossy layer greater than an amount of the white-based liquid using the white layer.

5. The liquid ejecting apparatus according to claim 1, wherein the control portion forms the glossy layer onto the white layer.

6. The liquid ejecting apparatus according to claim 5, wherein the control portion makes an amount of the white-based liquid using the white layer greater than an amount of the gloss-based liquid using the glossy layer.

7. The liquid ejecting apparatus according to claim 1, further comprising:

a recording head that includes the white-based nozzle group and the gloss-based nozzle group, and moves a first direction and a second direction opposite to the first direction;

wherein, the control portion forms the another layer onto the one layer of the white layer and the glossy layer, while moving the recording head in the first direction.

8. The liquid ejecting apparatus according to claim 7, wherein the control portion forms the another layer onto the one layer of the white layer and the glossy layer, while moving the recording head in the second direction.

9. A liquid ejecting method comprising:

ejecting a white-based liquid from a white-based nozzle group;

ejecting a gloss-based liquid from a gloss-based nozzle group; and

forming a white layer by using the white-based nozzle group, and a glossy layer by using the gloss-based nozzle group;

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wherein, forming another layer onto one layer of the white layer and the glossy layer.

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